MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2017/2018

PCM0016 – CHEMISTRY

(All sections / Groups)

28 OCTOBER 2017
2.30 p.m – 4.30 p.m
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 5 pages only excluding the cover page.
2. Attempt **ALL** questions. Distribution of the marks for each question is given.
3. Please write all your answers in the answer booklet provided.

QUESTION 1 [25 MARKS]

(a) Bromine exists naturally as a mixture of two stable isotopes, ^{79}Br and ^{81}Br, with relative isotopic masses of 78.92 and 80.92 respectively.

(i) Define the term relative isotopic mass. [1 mark]

(ii) Using the relative atomic mass of bromine, 79.90, calculate the relative isotopic abundances of ^{79}Br and ^{81}Br. [2 marks]

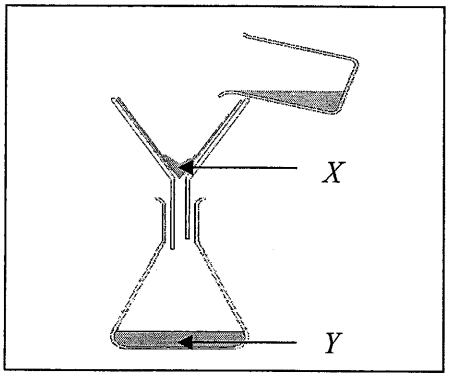
(iii) Bromine reacts with the element *X* to form a compound with empirical formula XBr_3. The percentage composition by mass of XBr_3 is *X*, 4.31; Br, 95.69. Calculate the relative atomic mass of *X*. [1.5 marks]

(b) Complete the table below by writing the chemical formulae, naming the compounds and identify the compounds as ionic or molecular:

Chemical formula	Name of compound	Ionic or molecular?
$CaBr_2$	(i)	(ii)
(iii)	Titanium (IV) oxide	(iv)
HF *(s)*	(v)	(vi)
(vii)	Dichlorine heptoxide	(viii)

[4 marks]

(c) The salt and water was separated from the insoluble impurities using the apparatus shown below.



(i) Give the name for this separation technique. [1 mark]

(ii) The salt and water was collected at *Y*. Explain why the insoluble impurities were held at *X*. [1.5 marks]

(iii) Name two other separation techniques that you know. [1 mark]

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(d) One mole of Zn reacts with 2 moles of HCl produces one mole of $ZnCl_2$ and one mole of H_2. In a chemical reaction, 31.4 grams of Zn reacts with 32.1 grams of HCl.
[Atomic mass: Zn = 65.4, H = 1.0, Cl = 35.5]

(i) Determine the limiting reagent and the excess reactant. [2.5 marks]
(ii) How many grams of $ZnCl_2$ will be formed at the end of this reaction? [1.5 marks]
(iii) If the actual yield of $ZnCl_2$ is 42.6 g, what is the percent yield? [2 marks]

(e) Boyle's Law describes a quantitative relationship between volume (V) and pressure (P) of a gas at constant temperature. Sketch a graph of P versus V in accordance to Boyle's Law. [2 marks]

(f) The combustion cylinder of an automobile engine has a volume of 560 mL and is filled with a combustible mixture of gasoline and air. If the mixture of gasoline and air is compressed from 1.0 atm to 3.5 atm, calculate the volume (in mL) of the mixture when it is fully compressed at 3.5 atm. [2 marks]

(g) The tire of a bicycle is filled with helium. The tire has a volume of 425 mL and a pressure of 7.82 atm at 25 °C. Calculate the mass of helium in the tire.
[Atomic mass: He = 4.00; the universal gas constant, R = 0.08206 L.atm/mol.K]
[3 marks]

QUESTION 2 [15 MARKS]

(a) The production of NO (*g*) follows this equation:

$$3\ NO_2\ (g) + H_2O\ (l) \rightarrow 2\ HNO_3\ (aq) + NO\ (g)$$

Calculate the enthalpy for the production of 1 gram of NO (*g*). Given the following thermochemical equations:
[Atomic mass: N = 14.0; H = 1.0; O = 16.0]

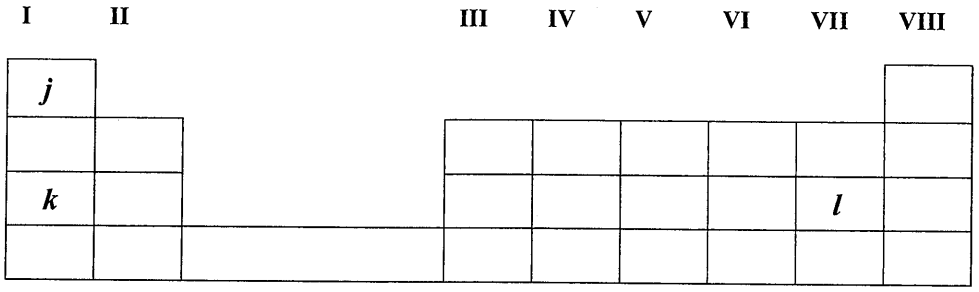
$2\ NO\ (g) + O_2\ (g) \rightarrow 2\ NO_2\ (g)$	$\Delta H = -116$ kJ
$2\ N_2\ (g) + 5\ O_2\ (g) + 2\ H_2O\ (l) \rightarrow 4\ HNO_3\ (aq)$	$\Delta H = -256$ kJ
$N_2\ (g) + O_2\ (g) \rightarrow 2\ NO\ (g)$	$\Delta H = +183$ kJ

[2.5 marks]

Continued...

(b) A sheet of gold weighing 10 g and at a temperature of 18 °C is placed flat on a sheet of iron weighing 20 g and at a temperature of 55.6 °C. What is the final temperature of the combined metals? Assume that no heat is lost to the surroundings.
[Specific heat, Au = 0.129 J/g·°C; Fe = 0.444 J/g·°C] [2 marks]

(c) Diagram shows the Periodic Table of elements. The following table shows one characteristic for each of elements *m*, *n* and *p*. The letters ***j***, ***k***, ***l***, ***m***, ***n*** and ***p*** do not represent the actual symbol of the elements.



Element	Characteristic
m	Located in Period 2 and has 6 valence electrons
n	Has electronic arrangement of $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$
p	Has a duplet in the only electron shell

Answer the following:
(i) Which element exists as a monoatomic gas? [0.5 mark]
(ii) Both ***k*** and ***n*** react with cold water to produce hydrogen gas. Which element reacts more vigorously? Explain [1 mark]
(iii) Draw the orbital diagram of valence electron for element ***l***. [1 mark]
(iv) Which element is not chemically reactive? State one application of the element. [1 mark]
(v) Arrange elements ***k***, ***m*** and ***p*** according to the size of the atoms that increase. [1 mark]
(vi) Which element, ***k*** or ***l*** is more electropositive? Explain. [1 mark]

(d) What is the maximum number of electrons in an atom that can have the following quantum numbers? Specify the orbitals in which the electrons could be found.
(i) $n = 2$, $m_s = +½$ [1.5 marks]
(ii) $n = 4$, $m_l = +1$ [1.5 marks]

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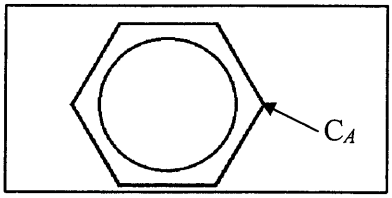
(e) For the following compound:



(i) Predict the correct hybridization for the carbon atom, C_A, indicated in the molecule shown. [1 mark]

(ii) Determine the number of sigma (σ) bonds and pi (π) bonds in the molecule. [1 mark]

QUESTION 3 [15 MARKS]

(a) Draw the Lewis structure and complete the table below:

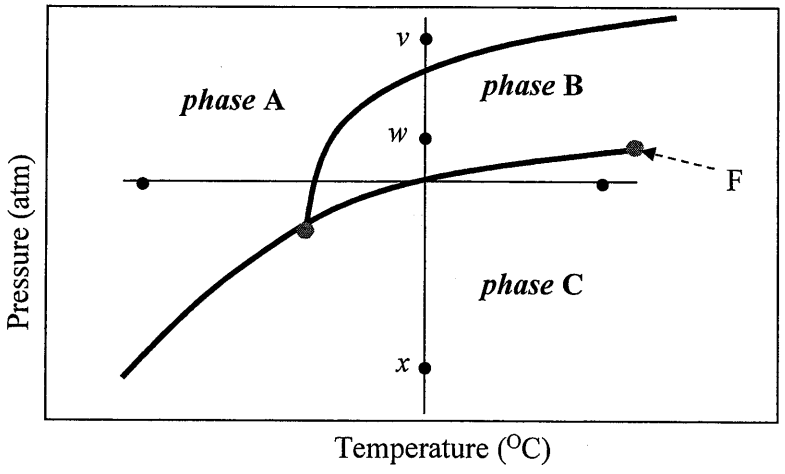
Compound	Lewis structure	Molecular geometry
PH_3		
$(CO_3)^{2-}$		

[3 marks]

(b) Figure below shows a phase diagram of carbon dioxide

(i) Write the correct phase for A, B, C and name point F. [2 marks]

(ii) Name the phase transition process from *v* to *w* and *x* to *w*. [1 mark]



(c) Calculate the pH of each of the following solutions.
[Atomic mass: Ba = 137.0; H = 1.0; O = 16.0; C = 12.0]

(i) A $Ba(OH)_2$ solution made from 7.06×10^{-3} g $Ba(OH)_2$ and enough water to make 3.0 L of solution. [2 marks]

(ii) 0.3 M HCOOH solution at 25 °C (K_a for HCOOH = 1.8×10^{-4}). [2.5 marks]

Continued...

(d) Determine how long (in hours) must a current of 4 A be maintained to electroplate 60 gram of calcium from molten $CaCl_2$.
[Atomic Mass: Ca=40.0; Cl=35.5; Faraday constant = 96500 C/mol e^-] [2 marks]

(e) The table below shows some reduction half-equations and their standard reduction potentials.

Reduction Half-Reaction	E^o_{red}
$Zn^{2+}(aq) + 2e \rightarrow Zn(s)$	− 0.76
$Ag_2O(s) + 2H^+(aq) + 2e \rightarrow 2Ag(s) + H_2O(l)$	+ 0.34
$Li^+(aq) + e \rightarrow Li(s)$	− 3.04
$F_2(g) + 2e \rightarrow 2F^-(aq)$	+ 2.87

(i) Identify the strongest reducing agent from the species in the table. Explain your answer. [1.5 marks]
(ii) Rank all the species from the lowest to the highest oxidizing agent. [1 mark]

End of Paper